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The Vegetable and Flower Seed Industry of California

by

R. L. Adams

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Acknowledgments

Mr. Darrell L. Johnson, a recent graduate of the University of California College of Agriculture, carried on most of the field work involved in this study and assisted materially in finally compiling the information and data. He was principally employed during the months of February and March 1951.

Appreciation is here also expressed to the seed company officers and fieldmen and to the cooperating growers for their aid and valuable information and data.

And, finally, appreciation is expressed to Mr. William H. Noble of San Francisco who by a generous grant to the College of Agriculture, University of California, made this study possible. As there were no restrictions attached to this grant, responsibility for the selection of this study rests solely with the College. This public acknowledgment of Mr. Noble's financial aid carries with it the thanks and appreciation of the College.

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Table of Contents

	Page
Introduction	1
Extent of the Industry	1
Seed Growing Contracts	2
General Aspects of the Seed Industry	3
Economics of the Vegetable and Flower Seed Industry	5
Cost of Production	6
Typical Vegetable Seed Production Data and Operating Costs	6
Beet Seed	6
Broccoli Seed	7
Cabbage Seed	9
Carrot Seed	10
Cauliflower Seed	12
Celery Seed	14
Lettuce Seed	15
Onion Seed	17
Pea Seed	19
Radish Seed	20
Tomato Seed	21
Yield and Price Data	22
Typical Flower Seed Production Data and Operating Costs	23
General Discussion of Flower Seed Production in California	23
Delphinium Seed	25
Larkspur Seed	25
Pansy Seed	26
Petunia Seed	27
Zinnia Seed	27
Appendix A	31
Appendix B	32
Appendix C	33

Table of Contents

	Page
Introduction.	1
Extent of the Industry.	1
Seed Growing Contracts.	2
General Aspects of the Seed Industry.	3
Economics of the Vegetable and Flower Seed Industry	4
Cost of Production.	6
Typical Vegetable Seed Production Data and Operating Costs.	6
Beet Seed	6
Broccoli Seed	7
Cabbage Seed.	9
Carrot Seed	10
Cauliflower Seed.	12
Celery Seed	14
Lettuce Seed.	15
Onion Seed.	17
Pea Seed.	19
Radish Seed	20
Tomato Seed	21
Yield and Price Data.	22
Typical Flower Seed Production Data and Operating Costs	23
General Discussion of Flower Seed Production in California.	23
Delphinium Seed	24
Larkspur Seed	25
Pansy Seed.	26
Petunia Seed.	27
Zinnia Seed	29
Appendix A.	31
Appendix B.	32
Appendix C.	33

The Vegetable and Flower Seed Industry of California

by

R. L. Adams[1/]

Introduction

One of California's important agricultural industries generally little known to those not identified with the industry is the production of vegetable and flower seeds. Occasionally, an article dealing with this important industry appears in a magazine or the agricultural press, but, in general, little is known of the interesting and extensive industry. It is the purpose of this report to better inform the layman of a few of the important aspects of this highly developed industry, with particular reference to its economic aspects, and to pay tribute to an industry that may not be as fully appreciated as it deserves. If it were not for those who have spent many years--frequently a lifetime--working to produce ample and better stocks, we would certainly lack the varied supplies of vegetables and the gorgeous displays of flowers. It is a simple matter to step up to a display rack of attractive packages. But a lot of work has gone into the breeding (or finding) of the best available varieties, the growing of the crop, its preparation for market, and arranging for widespread distribution. It is our hope that this account will convey some idea of the many details involved in making vegetable and flower seeds available to the growers of flowers and vegetables in the home gardens, in town and in the country, and for the truck gardens and fields of the commercial growers.

The housewife, family gardener, commercial grower, and the trade owe a continuing vote of thanks to these producers of flower and vegetable seeds. Working quietly and unassumingly, these growers make available a steady flow of seeds. They work increasingly to insure needed and adequate supplies, to create new and better varieties, to keep varieties true to type, to enhance resistance to disease, and to maintain high germination and viability. Without such goals the grower of vegetables or flowers--be he a large or a small planter--would certainly be in a bad way. Thus, the seed companies occupy a dual position. They produce for the market, putting up their seeds in attractive colored lithographed packages of various sizes as well as larger amounts in cloth bags for the wholesale market. In addition, most companies also conduct extensive breeding experiments in a continual search for better vegetables and more attractive flowers.

Extent of the Industry

Statistics concerning the seed-producing industries are difficult to compile. The best sources available to us are the annual reports of the County Agricultural Commissioners. But these are not necessarily complete, particularly if the business in a given county is confined to a single company

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1/ Professor of Farm Management and Agricultural Economist in the Experiment Station and on the Giannini Foundation.

adverse to publishing details of its operations. In other cases, flower and vegetable seeds are combined or may even include certain field crops seed (such as inclusion of mustard or sugar beets). Admittedly, the exact status of the business though interesting is not particularly vital.

A rough approximation of the vegetable and flower seed industry, compiled from fairly complete data, shows twenty out of fifty-eight counties reporting acreage of either or both vegetable and flower seeds.

The principal production of flower seeds, as reported by the Agricultural Commissioners and from our field inquiry, centered in Santa Barbara, Monterey, San Benito, San Luis Obispo, Los Angeles, and Ventura counties. Similarly, vegetable seed production valued at $50,000 or more was reported for Fresno, Imperial, Kern, Monterey, Riverside, Santa Barbara, Santa Clara, Sutter, and Ventura counties.

Eight counties reporting production of flower seeds in 1950 indicated an acreage of about three thousand acres (2,970) and a value of $1,184,611. Nineteen counties reported 8,137 acres in vegetable seeds, with a value of almost 2 million dollars ($1,925,066).

Growing of vegetable and flower seeds is carried on both by (1) the seed companies on owned or rented lands and (2) selected farmers who, under contract, produce for some company. There is no open market for vegetable or flower seeds. A grower who can negotiate a purchase contract is assured of a market, but producing without a contract is certainly hazardous.

Seed Growing Contracts

Private growers (as distinct from seed companies), in general, grow seed year after year depending, however, upon the contract price offered, the past profit experience, expected profit in relation to other crop enterprises, and growers' preference. The seed companies prefer to deal with these experienced growers and will contract to the extent of their sales estimates minus inventory and their own production. There appears to be little bargaining in regard to contract price since it is a relatively set figure for each variety.

Sacks, twine, and canvas are supplied to the grower by the seed company at no charge except for loss. The seed company usually supplies a thresher where needed either free of charge, with a charge based upon weight of seed threshed, or on an acreage basis, the charge being deducted from the grower's check. Some contracts provide that the seed company pay half the cost. There is also a credit clause in some contracts whereby the grower can borrow money from the seed company, the amount being dependent upon the condition of the crop and the purpose of the loan. None of the growers contacted were making use of this credit feature.

Growers are paid the contract price on the basis of recleaned seed which meets germination standards. The company is obligated to take the total seed, produced by the grower, that qualifies. Contracts always have a germination clause to the effect that germination must be above a stated minimum or there is a reduction in contract price or no payment whatsoever.

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Sacks, twine, and canvas are supplied to the grower by the seed company at no charge except for loss. The seed company usually supplies a thresher where needed either free of charge, with a charge based upon weight of seed threshed, or on an acreage basis, the charge being deducted from the grower's check. Some contracts provide that the seed company pay half the cost. There is also a credit clause in some contracts whereby the grower can borrow money from the seed company, the amount being dependent upon the condition of the crop and the purpose of the loan. None of the growers contacted were making use of this credit feature.

Growers are paid the contract price on the basis of reclaimed seed which meets germination standards. The company is obligated to take the total seed produced by the grower that qualifies. Contracts always have a germination clause to the effect that germination must be above a stated minimum or there is a reduction in contract price or no payment whatsoever.

General Aspects of the Seed Industry

Acreage of seed production changes every year depending upon the outlook for sales estimates and available inventory. Seed yields are extremely variable, with some varieties producing seasonal variations from 150 pounds per acre to 1,000 pounds per acre. This factor adds to the difficulty of determining yearly plantings of numerous varieties.

Vegetable seed crops require much labor for transplanting, thinning, hoeing, and harvesting. Growers hire needed labor from labor contractors in some cases and from seed companies in others. At the time of this study, Mexican Nationals were present in all areas working in the seed fields either under labor contractors or directly for seed companies. Migrant labor is also used when unoccupied in other agricultural fields.

Weeds must be kept under control as much as possible to prevent seed contamination. Weed seeds are removed at the seed mill by gravity, fans, or screens, but in some instances the weed seed is nearly the same size and weight as the seed being grown. An example is pigweed seed and celery seed. These seeds are different in color but of very similar size and weight making separation very difficult.

The control of insects and diseases is a major problem. Germination and yield are definitely decreased if aphids, lygus bugs, and other insects are not controlled. When seed pods are formed, insects burrow inside to destroy seed. Mildew and other fungus growth must be controlled during the life of the plant.

After the plants "bolt,"[1/] they become too tall to apply dust and spray with ground rigs and it is necessary to use air application by plane or helicopter.

Seed harvest comes along in midsummer and runs into late fall. The harvesting is done by machine or with hand labor. Many of the vegetable and most of the flower seeds are harvested by hand. The seed stocks are cut and spread on canvas sheets in the fields to dry.

Threshing is generally done by machine, but some seed, such as lettuce, is rubbed by hand (called "shagging") or is separated by using a roller and tractor.

Final storage and marketing of the seed are carefully done by the company. Bags of seed are labeled as to variety with a label inside the bag. This safeguards the identity of the seed in the event that the outer label is torn off or mutilated.

The seed is delivered to the company mill where it is recleaned. The company sends a germination sample to an agricultural laboratory to determine per cent germination. Minimum acceptable germination for vegetable seed is

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1/ Send up seed stalks.

[illegible]

[illegible] every year something [illegible] [illegible]
[illegible]). Seed yields are [illegible]
[illegible] several variations [illegible] [illegible]
[illegible] this [illegible] to the difficulty of detect-
[illegible] variations.

[illegible] seed crops require much labor for transplanting, thinning, hoeing, and harvesting. Persons hire seasonal labor from labor contractors who come to the seed companies in advance. At the time of this study, Mexican nationals were present in all areas working in the seed fields, either under labor contracts or directly for seed growers. Migrant labor is also used with increasing in other agricultural fields.

Weeds must be kept under control as soon as possible to prevent seed contamination. Weed seeds are removed as dirt and trash by winnowing, fans, or screens, but in some instances the weed seed is nearly the same size and weight as the seed being grown. An example is pigweed seed and celery seed. These seeds are different in color but of very similar size and weight, making separation very difficult.

The control of insects and diseases is a major problem. Germination and yield are seriously decreased if aphids, lygus bugs, and other insects are not controlled. Some seed crops are flowers, for example, lily of the valley seed. Mildew and other fungus growth must be controlled during the fall or the plant.

After the plants "bolt"[1] they become too tall to apply dust and spray with ground rigs and it is necessary to use the application by plane or helicopter.

Seed beet at cover along in midsummer and runs into late fall. The harvesting is done by one or two men and labor. Some of the equipment of the farmer's own are harvested by hand. The seed stocks are cut and spread on canvas to dry in the fields to dry.

Threshing is usually done by machine, but some seed, such as lettuce, is threshed by hand (called "treading") or is spread out by using a roller and bucket.

[illegible] bags of seed are labeled as to variety with a label inside the bag. This enables the quantity of the seed in the event that the outer label is worn off or mislabeled.

The seed is delivered to the company mill where it is cleaned. The company sends a representative sample to an official seed laboratory to determine per cent germination. Minimum acceptable germination for very little seed is

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1/ Bend up seed stalks.

usually 85 per cent, yet the majority of seed actually grades 90 to 99 per cent. Germination of flower seed differs greatly. It is very difficult to obtain germination results in the laboratory which will coincide with those in the field. The reason is apparently not known, but duplication of field conditions in the control laboratory is apparently not possible. Germination tests may run 10 to 99 per cent in the laboratory with reverse results in the field.

With vegetable seeds having below minimum germination percentage, it is sometimes possible to store the seed for a period of time during which the nonviable seed will shrink and lose weight and can then be separated giving a second sample that will measure up to germination standards. This reduces the income to the grower but prevents a complete loss.

Beans for seed represent a further problem with regard to "cylinder cracks." The bean sprout located just below the hard seed coating can easily be cracked when threshing and recleaning the bean. Five per cent "cylinder cracks" is usually the maximum allowable for seed beans. In the thresher the cylinder speed and spacing must be carefully watched to prevent this cracking. Equipment handling seed beans in the mill must be carefully designed and operated to prevent beans from falling any distance as this, too, will crack the coating and damage the seed. Nongerminating bean seed is sometimes stored in damp climate which will induce seed to germinate.

According to the trade, California-produced seed is considered superior to seed produced in other parts of the United States and foreign countries. Because of the favorable weather during harvest season and the warm growing conditions, both germination and viability are high.

One problem facing California producers today is high labor costs. This is particularly important to producers of flower seeds. Labor costs may run upward of $100 or more per acre for growing costs alone. Harvesting adds $50 to $75 per acre. High land values and high rents, plus increasing irrigation costs in most of the areas, also tend to raise the cost of production. Another factor affecting the seed industry is competition with foreign-produced seed. At present the tariff on vegetable and flower seeds is low. This is shown by the following table which sets forth the rates as written into the Tariff Act of 1930 (col. 2) and the rates prevailing in 1948 (col. 3) following several adjustments under provisions of the Reciprocal Trade Agreement Act as amended.

It is estimated that many varieties of flower seeds can enter this country at about one-quarter the cost of California production because of the much lower wage scale prevailing in foreign countries. In the major California flower seed producing area, it is said that the acreage has decreased by approximately one-third due to the increased importation of foreign seeds since the end of World War II. It is said that vegetable seed producers do not have to compete with imports to the extent that flower seedsmen must.

Seed producers in California are very much aware of this threat to their industry. The only apparent solution to the problem, as they visualize it, is an increase in tariff rates. Technological advances are being made by local producers wherever this can be done without sacrificing quality. But

technological changes alone cannot take care of the wide differences between foreign and domestic costs because the flower seed business is characterized by high hand-labor costs.

TABLE 1

Tariff Rates on Importations

Seed	Tariff rate 1930 Tariff Act	Tariff rate 1948
1	2	3
	cents per pound	
Beet (garden)	4	2
Cabbage	12	5
Carrot	4	3
Cauliflower	25	no change
Celery	2	1
Onion	15	no change
Parsley	2	no change
Parsnip	4	3
Pepper	15	10
Radish	6	2
Spinach	1	½
Flower	6	3
Not specifically provided for all seeds	6	2

Economics of the Vegetable and Flower Seed Industry[1/]

Inquiries into yields, contract prices, and costs of production which are significant economic aspects are outlined in some detail in the paragraphs which follow.

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1/ To provide data and information for this report, a field survey was conducted during the period February 7 to March 31, inclusive, 1951. Sixteen counties for which vegetable and/or flower seed production was reported were visited during this period. These counties were: Fresno, Imperial, Kern, Los Angeles, Merced, Monterey, Orange, Riverside, San Benito, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Stanislaus, and Ventura.

Seed companies contacted in this survey were both wholesale and retail producers. Many of the larger companies have fieldmen operating in the different producing areas. Companies contacted were: Associated Seed Growers, Inc., Bodger Seeds, Ltd., W. Atlee Burpee Seed Co., Denholm Seed Co., Waller-Franklin Seed Co., MacDonald Seed Co., Desert Seed Co., Ferry-Morse Seed Co., Geo. Loomis Seed Co., Rojas Seed Co., Kellogg Seed Co., Waldo Rohnert Co., Haven Seed Co., Germain Seed and Plant Co., Aggeler and Musser Seed Co., and Pieters-Wheeler Seed Co. In addition to these sixteen firms, there are another twenty-one or so California companies who, for lack of time, could not be contacted.

In addition, data were collected from over two score growers and seed company fieldmen available in each of the seed-growing localities visited.

Costs of Production

Data of costs are not too plentiful, but typical figures were determined during the course of our survey. Due to the strict competition present within the industry, many questions were left unanswered as they were considered confidential. This made it difficult to determine estimates of cost of production and average net returns to growers. In fairness to the companies it must be pointed out that costs are very difficult, if not impossible, to determine on some varieties as the acreage planted is very small. In flower seed production, plots as small as one-sixteenth of an acre may constitute the total acreage planted in one area. There is considerable spread between that price paid per pound to the grower and the final retail price. But it must be kept in mind that the price paid to the producer is only one of the costs of the seed company. They have many costs, including storage, distribution, breeding, and administrative, to consider when determining retail price.

General Costs.--General costs common to several kinds of seed were found to be as shown in Appendices A, B, and C.

Other Costs.--Using the general costs as set forth in the Appendices and adding costs applicable to a given seed crop, total figures for each of several vegetable seed crops were determined to be as set forth below.

Typical Vegetable Seed Production Data and Operating Costs

Beet Seed.

Beets are transplanted in December to early February to produce seed in July and August. The beets are transplanted to 36-inch rows on flat land. There are about 8,000 to 10,000 roots planted per acre which gives a spacing of approximately 18 inches. There may be a prefertilization of 700 to 1,000 pounds per acre of a complete fertilizer such as 10-10-5.

It is usually necessary to irrigate soon after planting plus two to three additional irrigations. Beets react well to early applications of ammonia gas if the prefertilizing is omitted or did not show adequate results.

Five cultivations are usually necessary and one hand hoeing to keep the weeds under control. Eventually, beets shade the ground thus reducing the weed problem.

Lygus bugs affect germination and thus affect yield if not controlled. Five per cent D.D.T. will give adequate control. It is used two to three times during the season in 50 pounds per acre applications and applied by airplane. In areas affected by rust, it may be necessary to use sulfur as a control measure.

After the beets have "bolted" and the seed stock is 12 to 15 inches high, it is tipped. This has the effect of causing the beet to become bushy. It sends up other seed stocks which increases the yield. Tipping is also done to prevent the beet from becoming too tall and blowing out of the ground in a hard wind.

[illegible]

Harvesting is usually done by hand; the seed stocks are cut and windrowed in the same operation and left to dry. A tractor-mounted mower is in use but is still in the experimental stage.

After about ten days' drying time, the best seed is threshed. The machine is usually either rented to the grower by the contracting seed company or threshing is contracted.

TABLE 2

Table Beet Seed: Cost of Production

(See Appendices A, B, and C for details)

Items	Cost per acre
Plowing	$ 3.82
Disking (2 times)	2.28
Harrowing (2 times)	.70
Prefertilizing:	
700 pounds of 10-10-5	28.00
Applying	1.51
Transplanting	2.57
Irrigating (3 times):	
Labor	6.75
Water (3 acre-feet)	9.00
Cultivating (4 times)	4.64
Hoeing (15 man-hours)	11.25
Dusting (3 times):	
150 pounds of D.D.T.	12.00
Applying	7.50
Harvesting (by hand; 35 man-hours)	26.25
Threshing (contracted at $1.25 per cwt., based on 1,875 pounds field run)	23.45
Taxes	10.00
Total	$149.72
Cost per pound (based on clean yield of 1,500 pounds)	10.0 cents

Broccoli Seed.

Planting broccoli for seed takes place in the fall and winter months of September through November throughout the state. One to 1½ pounds of seed are planted to the acre two rows to a bed. One pound of broccoli seed will produce approximately 48,000 plants, but by planting close and later thinning, there is a better chance of getting a full stand.

It is a general practice to irrigate soon after planting to insure adequate moisture until spring. Three to four more irrigations are needed in the spring, from March to the last of May.

Thinning is done when the plants have been in the ground about forty-five days. The plants are generally thinned to 14 inches, and the spacings are staggered to give the plant enough room for its side shoots.

Fertilizing consists of an application of 300 pounds per acre of a complete fertilizer such as 10-10-5.

It may be necessary to dust for aphis one to three times in the fall with 30 pounds per acre of 5 per cent D.D.T. Two or more dustings may also be necessary in the spring as aphides are quite troublesome in broccoli.

If the market is favorable, in December to January the growers may go through the field and remove the center bunch for sale since this practice causes the plant to produce more seed-bearing shoots. In some cases, this practice is followed even though the broccoli cannot be marketed since the amount of seed produced by the additional side shoots more than covers the cost of removing the center bunch. It may be necessary to give the broccoli an additional irrigation and 40 to 50 pounds per acre of ammonia gas right after cutting to insure good growth.

Two or three cultivations are required during the season, and it is generally necessary to hoe twice to control the weeds.

Broccoli seed is harvested in June and July throughout the state. The harvesting is done by the seed company in certain instances, but generally the grower does it himself or contracts the job. The seed is cut by hand and windrowed in one operation. After a drying period of three to five days, the seed is threshed with a harvester equipped with a pickup attachment.

TABLE 3

Broccoli Seed: Cost of Production

(See Appendices A, B, and C for details)

Items	Cost per acre
Plowing	$ 3.82
Disking (2 times)	2.28
Making beds	2.83
Planting	1.97
Irrigating (4 times):	
Labor	10.00
Water (2.5 acre-feet)	7.50
Cultivating (3 times)	4.08
Thinning (20 man-hours)	15.00
Hoeing (2 times; 10 man-hours)	7.50
Dusting (2 times):	
60 pounds of 5 per cent D.D.T.	4.80
Applying	3.00
Fertilizing:	
300 pounds of 10-10-5	12.00
Applying	1.51
Ammonia gas (30 pounds)	3.00
Removing centers (5 man-hours)	3.75
Harvest and windrow (by hand; 25 man-hours)	18.75
Threshing	14.88
Taxes	10.00
Total	$126.67
Cost per pound (based on yield of 1,000 pounds)	12.6 cents

[illegible]

Cabbage Seed.

Cabbage is planted in August and September for seed production. The seed is planted two rows on a bed, 1 to 1½ inches deep. The seed is sown at the rate of 2 to 3 pounds per acre. This gives a spacing of 3 to 4 inches, the plants later being thinned to 10 to 12 inches.

It is a general practice to irrigate soon after planting. The soil is usually quite dry in August and September, and some moisture is needed to start the plants growing. About three or four more irrigations are required through the season.

The soil must be cultivated about four times depending upon the weed problem. There are usually two hand hoeings during the season--the first time in late September or October after thinning and the second time in the spring around March.

About thirty days after planting, the cabbage is thinned to 10 or 12 inches. This spacing is large enough to allow ample growing room. As in other seed crops, a short-handled hoe is used to remove the excess plants. It requires a crew of thirty to forty men.

It is usually necessary to control insects, especially aphis, in the fall. One or two dustings with 5 per cent D.D.T. at the rate of 40 pounds per acre are used. There may be more dusting required in the spring.

To enable the seed stock to push its way through the cabbage head, it is necessary to remove part of the head. The head is usually cut off about one-third the way up, parallel to the ground, with a large knife. If the market price will justify it, the heads can be marketed and are removed leaving only a couple of wrapper leaves. The cabbage is usually headed in December or January.

In some areas the land is prefertilized with 250 to 300 pounds per acre of a complete fertilizer such as 10-10-5. A side dressing of 300 to 400 pounds is also used later in the season, or 60 to 80 pounds of ammonia gas is added.

Harvesting extends from July into September, the actual time depending on the locality and the time of planting. This is generally a hand operation and consists of cutting the seed stocks and piling in windrows. A machine is available that cuts the stocks and conveys them into a windrow by means of a drapper, but the hand method seems to be used more often. After a drying period, the seed is threshed in a small machine. The seed company sometimes rents the grower a machine and sometimes does the complete harvest, the cost being deducted from the seed payment.

[illegible]

[illegible]

[illegible]

TABLE 4

Cabbage Seed: Cost of Production

(See Appendices A, B, and C for details)

Items	Cost per acre
Plowing	$ 3.82
Disking (2 times)	2.28
Making beds	2.83
Planting	1.97
Irrigating (4 times):	
Labor	9.00
Water (3 acre-feet)	9.00
Cultivating (4 times)	5.44
Thinning (25 man-hours)	18.75
Hoeing (2 times; 10 man-hours)	7.50
Fertilizing:	
400 pounds of 10-10-5	16.00
Applying	1.51
Dusting (2 times):	
80 pounds of 5 per cent D.D.T.	6.40
Applying	4.00
Removing heads (15 man-hours)	11.25
Harvesting and windrowing (by hand; 25 man-hours)	18.75
Threshing	14.88
Taxes	10.00
Total	$143.38
Cost per pound (based on yield of 1,200 pounds)	14.0 cents

Carrot Seed.

Carrot seed is produced by transplanting the complete mature carrot. Transplanting takes place from November to December in Fresno County, from December to January in San Benito County, and as late as January and February in Riverside and Ventura counties. The carrots are planted one row to a bed or on the flat in rows 3 feet apart. Planting procedure depends on the character of the soil and grower's preference. From 8,000 to 12,000 roots (about 1 ton) are planted to the acre. The root stock is generally supplied by the seed company. In some cases, there is a charge of $20 to $25 per acre, and in others there is no charge. The contract price will vary depending upon whether the roots are supplied.

In some areas the land is prefertilized with 500 to 1,000 pounds per acre of a complete fertilizer such as 10-10-5. There is usually a side dressing of about 400 pounds per acre with more nitrogen such as 16-20-0 or 17-7-0 after four months. Some growers prefer 150 to 200 pounds per acre of ammonia gas in place of the complete fertilizers.

In some areas, depending on the rainfall, it is necessary to irrigate the carrots right after planting. There are usually three to five irrigations and four to six cultivations throughout the season. There have been trials, reported successful, by the use of 35 gallons per acre of stove oil to kill the early weed crops. Usually, two weedings are needed during the season depending how heavy the weeds are.

Lygus bugs are liable to be troublesome and, if not controlled, bore into the seed and decrease both yield and germination. Two to three dustings may be necessary in the season to obtain control (generally, 5 per cent D.D.T. is used), but in some instances it has been necessary to use 10 gallons per acre of a 25 per cent D.D.T. emulsion. Spraying and dusting are done by airplane or helicopter. Thrip must also be controlled but is not as serious as lygus bugs. If rust is present, it will also affect carrot seed but is generally a secondary problem.

Harvesting generally takes place during August to September. Carrot seed can be harvested in one of three ways. If there are no weeds present, it is possible to use direct combining, cut the stocks by hand or by machine, and pile on canvas sheets. Because of the seed lost through the combine, this method is not used extensively. The returns will be almost the same by using hand labor so there is no gain in the end by using the combine. In areas where the soil is light, it is not possible to use the mowing machine as the stocks will pull out of the ground instead of being cut. At harvest time the stocks and carrot roots become very tough and are difficult to cut or break. The stocks grow to heights of from 4 to 5 feet, and the seed pod at the top is heavy enough to cause the plant to fall and pull the root out of the ground. The carrots are often planted as close as 6 to 8 inches to allow them to lean on each other and prevent their pulling out.

After a ten-day drying period, the carrot seed is either threshed by machine or rolled with a tractor and roller.

TABLE 5

Carrot Seed: Cost of Production

(See Appendices A, B, and C for details)

Items	Cost per acre
Plowing	$ 3.82
Disking (2 times)	2.28
Furrowing (2 times)	1.10
Prefertilizing:	
500 pounds of 10-10-5	20.00
Applying	1.33
Transplanting	2.57
Fertilizing growing crop:	
400 pounds of 17-7-0	14.40
Applying	1.33
Irrigating (4 times):	
Labor (12 man-hours)	9.00
Water (3 acre-feet)	9.00
Cultivating (5 times)	6.80
Dusting:	
80 pounds of 5 per cent D.D.T.	6.40
Applying	4.00
Hoeing (2 times; 15 man-hours)	11.25
Harvesting (by hand; 35 man-hours)	26.25
Threshing (by contract; 1,400 pounds field run at 75 cents per cwt.)	10.50
Taxes	10.00
Total	$155.76
Cost per pound (based on a recleaned yield of 800 pounds)	19.4 cents

Cauliflower Seed.

The Snowball variety of cauliflower is planted in September and October to produce seed in the following August. This report is for the Snowball variety as the growers contacted were growing principally that variety. The Broccoli variety has a very similar growing habit but is two months earlier being planted in July to produce seed in the following June.

Cauliflower is seeded about 3/4 to 1 pound per acre, 1 pound of seed producing in the vicinity of 60,000 plants. The land is worked up into beds 36 inches apart with one row to a bed.

In about sixty days the cauliflower is thinned to 18 to 24 inches to allow ample growing room. Cauliflower will not do well if confined to a small growing space.

Generally, four cultivations are required through the season, the first one being before the thinning operation. In addition, it is necessary to hoe the field twice to control the weeds.

[illegible]	[illegible]
[illegible]	[illegible]
[illegible] contribution:	
200 pounds of 10-10-5	20.00
Applying	1.25
Transplanting	[illegible]
Permit [illegible]	
Non-cash of 12.75	[illegible]
[illegible]	
Production (4 tons)	
Labor (12 man-hours)	[illegible]
Water (3 acre-in.)	[illegible]
Cultivation (5 times)	[illegible]
Insecticides	
[illegible]	[illegible]
Harvesting	[illegible]
[illegible]	
Transporting (by [illegible])	[illegible]
Marketing (by contract; 1,000 sample field was at 25 cents per crate)	10.00
Total	[illegible]
Gross	[illegible]
Net	[illegible]
Cost per pound (based on a yield of 800 crates)	12.4 cents

The Jewel variety of cauliflower is planted in 5 counties and ready to produce seed in the following months. This varies in the Jewel variety as are [illegible] cauliflower [illegible] variety. The broccoli variety is a very [illegible] variety and is ready earlier being planted in only the [illegible] in the following June.

Cauliflower is seeded about 3/4 to 1 pound per acre, 1 pound of seed produces in the vicinity of 5,000 plants. The [illegible] 14 inches 14 inches apart. [illegible] per to a [illegible].

In about sixty days the cauliflower is believed to [illegible] as [illegible] growing [illegible]. [illegible] [illegible] [illegible].

Generally, [illegible] [illegible] [illegible] the [illegible]. [illegible] [illegible] [illegible]. In addition, it is necessary to [illegible] [illegible] [illegible] the weeds.

Because of September planting, it is usually necessary to irrigate once before the rains; a total of five irrigations is generally required during the season.

A side dressing of 350 to 400 pounds of a commercial fertilizer, rich in phosphorous, is usually applied shortly after thinning. A common fertilizer used is 11-48-0 for a heavy application of phosphorous seems to increase germination. If the soil is slightly depleted at planting time, it is advisable to prefertilize with a complete fertilizer such as 10-10-5.

One or two dusting are required to control insects, especially aphis. Aphis, if not adequately controlled, will bore into the seed pods and blight the seed decreasing both yield and germination. One 50-pound per acre application of 5 per cent D.D.T. in July may give the control.

The heads are cut by hand in the latter part of August and laid in the field to dry. After three to four days in the field, they are piled on canvas sheets to dry completely. Threshing is done with an A.C. All Crop thresher possibly supplied by the seed company. The machine can do about 2 acres per day and, in addition, requires two men, one of which may be supplied by the seed company, and a tractor.

Because of the large amount of seed per pound, there is not a very large acreage of cauliflower seed raised each year; also, the crop requires quite a bit of care to insure a good yield. The crop must be kept moist and fertile as cauliflower will not withstand droughts.

TABLE 6

Cauliflower Seed: Cost of Production

Items	Cost per acre
Production of cauliflower seed parallels the methods used in producing cabbage seed. There are a few minor differences, however.	
Items of plowing, disking, making beds, planting, irrigating, cultivating, thinning, hoeing, fertilizing, and dusting--all preharvest items--total about the same as cabbage.	$ 88.50
Harvesting is somewhat different. This operation calls for cutting the heads by hand (involving 20 man-hours) and piling on sheets (another 3 man-hours per acre)--a total of 23 man-hours.	17.25
Threshing cost is about the same.	14.88
Taxes are the same.	10.00
Hence: Total cost of production, per acre	$130.63
Cost per pound of seed (based on a yield of 350 pounds)	37.3 cents

Celery Seed.

Celery root stock is transplanted in the month of December to produce seed in September and October. The plants are spaced 8 to 10 inches apart in one row on a bed. The roots of transplants are 2 to 3 inches in length and are planted 1 to 2 inches deep. The plants are not disturbed for about thirty days to be sure they take root.

It is necessary to cultivate celery six times during the season and hand hoe two to three times. After about four months, it is impossible to get into the field with equipment and any weed control from then on is done by hand.

Six irrigations throughout the season are generally sufficient. Celery must not be allowed to dry out for any length of time as it will retard the plants considerably.

Aphis and lygus must be effectively controlled to produce a high germinating crop of celery seed. It is necessary to dust three to four times to maintain adequate control of the insects.

A side dressing of 400 to 500 pounds per acre of a complete fertilizer is usually applied in the spring in March or April--10-10-5 seems to fulfill the requirements. Some growers, in addition to the side dressing, apply 400 to 600 pounds of ammonia gas later in the season around May. The ammonia gas gives the celery a good boost and produces considerable growth.

The harvest is mainly done by hand labor, but some growers use a semi-machine method in which the seed stocks are cut by a mower arrangement, and men following the tractor spread the stocks on a canvas sheet to dry. The celery stocks are turned twice on the canvas to allow even drying and prevent the stocks from heating up. The seed is dried for about two weeks.

Threshing is done by machine usually supplied to the grower at no direct charge. The process is quite slow as the seed must be very dry to thresh and is run through the machine very slowly. It takes approximately 8 hours of threshing to care for 1 acre under good conditions.

TABLE 7

Celery Seed: Cost of Production

(See Appendices A, B, and C for details)

Items	Cost per acre
Plowing	$ 3.82
Disking (2 times)	2.28
Making beds	2.83
Transplanting	2.57
Cultivating (6 times)	8.16
Irrigating (6 times):	
Water (3½ acre-feet)	10.50
Applying (18 man-hours)	13.50
Hoeing (3 times; 10 man-hours)	7.50
Fertilizing:	
(a) 400 pounds 10-10-5	32.00
Applying	1.33
(b) 400 pounds total ammonia, applied in 3 irrigations	40.00
Dusting (3 times):	
150 pounds 5 per cent D.D.T.	12.00
Applying	7.50
Harvesting (hand; 50 man-hours)	37.50
Threshing (3M 10T thresher--cost per day, $42.75; output, 1 acre; and cost per acre, $42.75)	42.75
Taxes	10.00
Total	$234.24
Cost per pound (based on yield of 1,100 pounds)	21.3 cents

Lettuce Seed.

Lettuce for seed is planted from September 15 to March 15 depending upon the variety and the weather conditions of the area. September plantings take place in Imperial Valley only; the other areas begin in December. The seed is planted two rows on a bed about 1 to 2 inches deep. Approximately 1 pound per acre is seeded. This rate gives a very close stand. When the plants are about 2 inches high, they are thinned to 8 to 10 inches apart. The reason for planting heavy and then thinning is to insure a stand. Thinning 15 to 30 acres requires a large number of men, as many as thirty-five to forty men at one time, hired as a crew. The operation is performed with a short-handled hoe. The men work in a stooping position and grub out the plants leaving one every 8 to 10 inches. Weeds are also hoed out when thinning. A heavy growth of weeds slows down the thinning considerably.

After the lettuce has headed, it is necessary to go through the field and remove the heads either by smashing them or cutting them in half or completely removing them. The head must be cut or smashed to allow the

[illegible]

[illegible]

seed stock to push its way through. When the seed stock appears, the lettuce is said to be "bolting." In the Imperial Valley the head is removed and marketed if the price justifies. This reduces the cost of growing the seed. The yield will not be as great as if the field had been planted for market as a portion of the crop is removed when the field is rogued. Roguing is done by the seed company, and its purpose is to pull out any plants which are not true to type. As high as 50 per cent of the stand may be removed under extreme circumstances. Areas other than Imperial Valley reported marketing the heads as impossible since it is necessary to remove them before they had become solid and therefore of little or no value.

In most regions the seed is harvested around July and in May and June in Imperial Valley. The majority of the seed is cut by hand and piled on canvas sheets to dry and cure. These large canvas sheets are supplied by the seed company and are laid out through the field usually two to three to an acre. There is a mowing machine to cut the seed stocks, but it is in very limited use. The seed pods will break open very easily and scatter the seed at harvest time, and the machine reportedly shatters the seed too freely.

After two to three days drying, the piles must be turned over to prevent heating and mildew. This is a hand operation. When the seed is thoroughly dry, the edges of the canvas are rolled over which then encloses the seed in a large bag. These bags are then rolled under a tractor and roller to break the stocks and pods and to break all the seed loose from the pods. The seed is then either run through a small harvester or a fanning machine to remove the stocks and chaff.

Due to the dryness in Imperial Valley, lettuce seed there is harvested by a method called "shagging." Workers go through the field with a canvas bag held open by a wire ring, the ripe seed pods then being placed inside the bag and rubbed by hand to break the seed loose. A second harvest is usually necessary in about ten days to collect the ripening seed. This method is used in preference to the others as it reduces shattering.

To get high germinating lettuce seed, it is necessary to control aphis, lygus, thrip, and fungi such as mildew. This is generally accomplished by air applications of 5 per cent D.D.T. and sulfur.

TABLE 8

Lettuce Seed: Cost of Production

(See Appendices A, B, and C for details)

Items	Cost per acre
Plowing	$ 3.82
Disking (2 times)	2.28
Making beds	2.83
Prefertilizing:	
500 pounds of 10-10-5	20.00
Applying	1.33
Preirrigating:	
Labor	2.25
Water (3/4 acre-foot)	2.25
Planting	1.97
Irrigating (4 times):	
Labor	9.00
Water (1 acre-foot)	3.00
Cultivating (5 times)	6.80
Thinning (22 man-hours)	16.50
Weeding (2 times; 10 man-hours)	7.50
Dusting (2 times):	
80 pounds 5 per cent D.D.T.	6.40
Applying	4.00
Harvesting (by hand; 25 man-hours)	18.75
Curing (turning piles; 3 man-hours)	2.25
Rolling (1M 10T roller--cost per day, $23.25; output, 1 acre; cost per acre, $23.25)	23.25
Beating and cleaning (2M; total 6 hours)	4.50
Taxes	10.00
Total	$148.68
Cost per pound (based on yield of 400 pounds)	37.2 cents

Onion Seed.

To produce onion seed it is necessary to plant onion bulbs (called "sets") in the fall of the year, September to November. The bulbs are transplanted into 3-foot rows spaced about 6 inches apart. The transplanting is done by machine with men following to set the bulbs in an upright position. After taking root, they are covered with soil and left in the field to lie dormant through the winter. In the spring the bulb sprouts and continues growing. Later in the spring, the onion bolts and sends up the seed stock. The seed stock generally grows to about 5 feet in height. One bulb may send up four to five stocks. The seed pod forms on the top of the stock.

During the growing season, it is necessary to irrigate and fertilize the onion. The weeds must be kept down in the early part of the season by hoeing

and cultivating as it is impossible to get into the field when the seed stocks gain in height. Selective sprays have been used with success on the early weed crops. The time of application is when the onions are about 2 inches high.

In the Imperial Valley it is possible to grow onion seed on a "seed-to-seed" basis. Planting 4 to 6 pounds per acre of seed in September to October, the bulb will grow and is left in the ground. Starting in the spring, it will also bolt as do the onions grown from sets.

It is very important to control thrip when producing onion seed as they bore into the seed pods and decrease yield and germination. Five per cent D.D.T. and sulfur applied by air is the most widely used control.

Harvesting is mostly a hand operation; the seed stocks are cut and spread on canvas sheets to dry. It is necessary to turn the piles over as with lettuce seed.

Onion seed is generally threshed by machine--either the cylinder-rub bar type machine or a rubber-roller bean type. Germination is lowered if careful harvest methods are not used. The seed will crack quite easily and when cracked fails to germinate. In some areas growers choose the rolling and fanning method of harvest. This is more expensive due to the labor required and the slowness, but they believe they are ahead because of the higher germination obtained.

TABLE 9

Onion Seed: Cost of Production (From Sets--Bulbs)

(See Appendices A, B, and C for details)

Items	Cost per acre
Plowing	$ 3.82
Disking (2 times)	2.28
Furrowing (3 times)	2.16
Transplanting	2.57
Setting bulbs upright (15 man-hours)	11.25
Irrigating (6 times):	
Labor	13.50
Water (3 acre-feet)	9.00
Cultivating (5 times)	6.80
Fertilizing:	
700 pounds of 10-10-5	28.00
Applying	1.33
Dusting (4 times):	
160 pounds of 5 per cent D.D.T.	12.00
Applying	8.00
Hoeing (2 times; 30 man-hours)	22.50
Weeding (60 man-hours)	45.00
Harvesting (by hand; 35 man-hours)	26.25
Curing (drying)--(6 man-hours)	4.50
Threshing (cost per day, $14.88; output, 2 acres; cost per acre, $7.44)	7.44
Taxes	10.00
Total	$216.40
Cost per pound (based on a yield of 600 pounds)	36.1 cents

Pea Seed.

Garden variety peas are planted for seed in January at the rate of 60 pounds per acre. They are planted in 26-inch rows on flat ground. It is generally not necessary to preirrigate, but if the soil is abnormally dry due to little rainfall, it is necessary to preirrigate or follow planting with an irrigation. There are generally five irrigations during the season including one of those mentioned above.

Three cultivations, plus two hoeings with a rotary hoe, are needed to keep the early weed crop under control. The rotary hoe can be used up to the time the plants are approximately sixty days old. In addition to the above hoeings, it may be necessary in some areas to hoe once more by hand.

It is usually necessary to dust one to two times for insects using 5 per cent D.D.T. in 50 pounds per acre applications, or some growers prefer B.H.C. at 30 pounds per acre. Dusting is done by air when the peas are in blossom.

The peas are harvested in the latter part of June using the same equipment as in harvesting beans. The peas are cut with a bean cutter mounted on a tractor. The peas are windrowed the same day and left to dry for ten to fifteen days depending on weather conditions. Threshing is usually hired using the rubber-roller bean-type thresher. The price is 50 cents per hundredweight in the dirt, the loss due to dirt and waste amounting to 10 to 15 per cent.

The contract price on seed peas has steadily decreased since 1946, the price being 6-1/4 cents per pound in 1950. There has been a corresponding decrease in the acreage planted in California as the growers feel this price does not cover their cost of production. Peas can be raised at a lower cost in Oregon than in California, but there is more risk involved. The heavy rains have washed out the crop in Oregon on different occasions. Therefore, the seed companies continue to plant a smaller California acreage as a hedging measure so that they will have a portion of their needed seed in the event that the Oregon crop is washed out.

TABLE 10

Garden Pea Seed: Cost of Production

(See Appendices A, B, and C for details)

Items	Cost per acre
Plowing	$ 3.82
Disking (2 times)	2.28
Furrowing	.72
Planting	1.97
Irrigating (5 times):	
Labor	11.25
Water (2 acre-feet)	6.00
Cultivating and furrowing (3 times)	4.08
Hoeing (2 times):	
(1M 10T rotary hoe--cost per day, $17.10; output, 30 acres; cost per acre, $.57)	1.14
Hoeing (by hand; 10 man-hours)	7.50
Dusting (1 time):	
50 pounds D.D.T.	4.00
Applying	2.00
Cutting vines:	
(1M 10T cutter--cost per day, $17.19; output, 30 acres; cost per acre, $.57)	.57
Raking vines:	
(1M 10T side-delivery rake--cost per day, $17.10; output, 25 acres; cost per acre, $.68)	.68
Threshing (contracted at 50 cents per 100 pounds, yield of 2,200 pounds)	11.00
Taxes (land double cropped)	5.00
Total	$ 62.01
Cost per pound (based on a yield of 2,200 pounds)	2.8 cents

Radish Seed.

Radish for seed is planted from December to January. The seed is planted two rows on a bed, the beds being 36-inch centers. The seed is planted 8 to 10 pounds per acre; this gives a very heavy stand which is thinned to 1 to 2 inches thirty to forty-five days after planting.

Three irrigations from April to July are necessary with ammonia gas being applied at the rate of 50 pounds per acre on the first and third irrigations.

Radishes are usually cultivated three times, the third cultivation being in April as it is impossible to get into the field with equipment after April.

Some years it is not necessary to dust, but if aphis is bad, a dusting is given using 35 to 40 pounds per acre of D.D.T. applied by air.

Two hoeings are generally required, but they are lighter operations than is the case with most seed crops. Radishes have a very dense stand only being thinned to 1 to 2 inches. Therefore, they shade the ground which reduces the weed problem.

Harvesting is done by machine in July. A mower and a side-delivery rake mounted on a tractor complete the operation in one trip through the field.

After three to four weeks' drying time, the radish seed is threshed. The complete threshing job is done by the seed company, usually, as it requires a large special-type radish thresher. There is no charge for the threshing, but it is taken into account when the contract price is determined.

TABLE 11

Radish Seed: Cost of Production

(See Appendices A, B, and C for details)

Items	Cost per acre
Plowing	$ 3.82
Disking (2 times)	2.28
Harrowing (2 times)	.70
Making beds	2.83
Planting	1.97
Irrigating (3 times):	
Labor	6.75
Water (2.5 acre-feet)	7.50
Cultivating (3 times)	2.08
Thinning (20 man-hours)	15.00
Fertilizing (100 pounds of ammonia gas):	
(½ each during first and third irrigations)	10.00
Dusting (1 time):	
40 pounds of 5 per cent D.D.T.	3.20
Applying	2.00
Hoeing (2 times; 7 man-hours)	5.25
Harvesting--cutting stalks and windrowing	
(contracted at $10.00 per acre)	10.00
Threshing (done by seed company)	--
Taxes	10.00
Total	$ 83.38
Cost per pound (based on a yield of 1,200 pounds per acre)	7.0 cents

Tomato Seed.

Tomatoes raised for seed are grown in the same manner as tomatoes raised for canning. If the crop is grown from seed, the planting is done around the first of April. If the crop is raised from transplants, the transplanting is done in May and June. The only difference between a crop

of tomatoes raised for canning or for seed is that the seed crop is rogued by the seed company. This may reduce the yield 10 to 25 per cent depending upon the field. If the field appears to be true to type, there may be only a slight reduction in yield from that of a crop for canning. The seed tomatoes are taken no matter what their condition. If they are soft but can be removed from the plant and put in a bucket, the seed company will accept them.

A good yield of tomato seed is estimated at 10 to 15 pounds of seed per ton of fruit. Taking an average of 15 tons per acre of tomatoes for canning, reducing it by 10 per cent to account for roguing, and multiplying it by an average of 12 pounds of seed per ton of fruit gives an average of 162 pounds of seed per acre.

There is no contract price based upon number of pounds of seed produced, but, instead, the price is based upon the tonnage per acre. This price follows very close to that paid by the canners. The roguing decrease is very nearly offset by the fact that the seed company takes the complete crop providing it is still attached to the vine.

Picking takes place from September to late October. The seed company attempts to pick all the tomatoes in two trips through the field. They try to go through the field when the ripest tomatoes are still on the vine and collect those that are ripe. If the seed has matured, there is no danger from frost, but if the seed has not reached full maturity, the frost will blight the seed and reduce germination of the immature seed. A tomato ready for market has mature seed.

The tomatoes are dumped into fermentation vats to ferment the pulp. In the average warm weather, this takes place in about seventy-two hours. The fermented pulp rises to the surface of the vat and is scraped off. The seed is heavy and remains on the bottom of the vat. The seeds and water are turned out of the vat and the seed is collected in a trough resembling a sluice box with baffles to collect the seed.

The operations and cost per acre for raising tomatoes for seed are the same as those followed in producing a crop for the cannery and, hence, require no detailed presentation of costs.1/

Yield and Price Data

Data of yields, as developed during the course of our field survey, are set forth in Column 2 of the following table (no. 12). Price data approximate prices paid to growers under contract.

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1/ For details of producing canning tomatoes, see pages 176-177 of Farm Management Crop Manual by R. L. Adams.

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[illegible]

[illegible]

TABLE 12

Vegetable Seed Yields and Prices

Seed crop	Yield	Price
	pounds per acre	cents per pound
Beet (table)	1,400-1,600	20
Broccoli	800-1,200	25
Cabbage (Snowball)	1,000-1,500	45a/
Carrot:		
Danvers Half Long	600- 700	33
Imperator	700- 900	33
Chantenay	800- 900	33
Cauliflower (Snowball)	350	200
Celery	900-1,300	75-95
Lettuce:		
Imperial	175- 600	95
615	420- 500	95
Great Lakes	125- 400	95
Cornell	300- 660	60
Premier Great Lakes	200	95
Onion:		
Sweet Spanish	500- 600	70
Bermuda	500- 700	80
Grono	500- 600	70
Pea	2,200	6.25
Radish	1,200-1,400	19

a/ Thirty cents for 1951 plantings.

Typical Flower Seed Production Data and Operating Costs

Flower seed production differs from vegetable seed production in many ways. A large percentage of the flower seed is grown by the seed companies as it is a more difficult, costly, and specialized crop to raise. The majority of vegetable seed, on the other hand, is grown under contract. Hand labor requirements are much greater in the growing of flower seeds than is the case with vegetable seeds. Some varieties must be hand pollinated to produce seed. Flower seeds are also grown in much smaller plots which would make contracting difficult.

General Discussion of Flower Seed Production in California

Planting begins around November for the earlier varieties of flowers and is an almost continuous process until April. Some varieties are seeded before the frost or cold period and others, after the danger of a cold snap. The time of harvest is an important factor in determining the date of planting. Weather conditions at this time must be clear with little wind and moisture. The time of the first fall cold spell is also taken into account in connection with certain varieties since frosts interfere with maturing of such seeds resulting in low germination.

The cultivation period runs from February to around September. Water and fertilizer requirements for seed production are not as heavy as they are for raising a market crop of flowers. It is important that no water be put on the flower crop when it starts to seed or the seed will not fill out; it will be "shoe-pegged." The exact time to stop irrigating is different for every variety and must be determined by experimentation. The weeds must be kept under control during the season, especially in the early part of the season when it is still possible to get into the field with machinery. If the weeds are allowed to get a good start, it is nearly impossible to control them after the plants have grown so that use of implements is ruled out.

Yields of flower seed are very variable. A general average for sweet peas of different varieties would be approximately 300 to 400 pounds per acre, but there have been yields running from 50 pounds or less to 2,000 and above.

Harvesting time is from July until December depending upon the date of planting and the length of the growing season. The majority of the harvesting is done by hand; workers pick the flower stalks and pile on canvas sheets to dry. Threshing is usually done by machine. It is a very slow process as the seed is fed into the thresher at a very slow rate to prevent blowing the seed over the back of the machine or not getting it completely clean.

Flower seed crops must be protected from insects and fungi to produce seed of high germination. Insects and fungi not only lower germination but greatly decrease yields. Many dustings and sprayings may be necessary during the season. Many different commercial insecticides are used to combat different insects; the most popular appears to be the 5 per cent D.D.T. The early dustings are done with hand rigs, but later in the season when most of the dusting is done, it is necessary to use air application by airplane or helicopter.

Some of the varieties of flowers must be hand pollinated to produce seed. This involves dusting the female plant by means of a small brush with the pollen collected from the male plant. The operation requires experience and patience to do a complete job. Flower seed acreage is relatively small compared to vegetable seed acreage. Plots one-sixteenth of an acre may comprise a whole season's production of a certain variety.

The high degree of specialization and the amount of labor need to produce a flower seed crop are two important reasons why the majority of the flower seed is produced by the flower seed companies themselves instead of contracting the acreage. Also, the small acreages which would be contracted would not be attractive to the independent grower. There are some varieties of flowers that are contracted--they are the more popular, home garden varieties such as zinnias, pansies, larkspurs, sweet peas, and petunias. Even these more popular varieties are seldom contracted in acreages exceeding 10 acres to a single grower.

Some specific examples of different varieties of flower seeds grown by contract farmers are given below.

Delphinium Seed.

The perennial delphinium is one of the few perennial flowers grown from seed. They will bloom generally three times if the spikes are not allowed to go to seed. When the spikes are permitted to go to seed, the first crop is harvested in September. The seed is cut by hand and dryed on sheets. After the seed is thoroughly dry, it is threshed by machine. If the plants are then cut back almost to the ground, they will produce a second crop of seed in the following April and May. The second seed crop will produce more seed than the first if protected from insects and if the winter is not too severe. The delphinium is one of the very few plants that will produce a second seed crop if allowed to lie dormant during the winter. The total yield of delphinium seed may run anywhere from 30 to 400 pounds per acre from the single planting. The plant requires considerable water during the first growing period and a lesser amount in the second period.

The general planting time for delphiniums is in March. The plant requirements are very much like those of the other flowers--500 to 600 pounds of fertilizer with only about 10 per cent nitrogen to keep foliage down, plenty of water, insect protection, and weed control.

Larkspur Seed.

One acre of larkspur plants in San Benito County was grown by one farmer as follows:

1. The land was worked up into 30-inch beds.

2. Planting was done in the early part of February. The seed was planted two rows on a bed. The planting was done by the seed company at no direct charge to the grower.

3. There were three cultivations during the season costing $8.00 per cultivation. The dates were March 16, April 1, and April 15.

4. The crop was irrigated four times; the first time was on April 12 and the last time was during the latter part of May. The grower estimated the cost to be $3.00 per irrigation for the water, and the operator did the labor.

5. Thinning and the first hoeing were done in the same operation on April 12. The expense was $48.00 for the 1 acre.

6. A second hoeing was done on June 1 at a cost of $12.00 for the acre.

7. The dusting was taken care of by the seed company at no direct charge to the grower.

8. The complete harvest and threshing was taken care of by the seed company.

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Total Cost to the Grower

	Growing cost in round numbers
Land preparation	$ 5.00
Irrigation	12.00
Cultivation	24.00
Thinning and first hoeing	48.00
Second hoeing	12.00
	$101.00
Returns for the clean seed	$212.00

Pansy Seed.

The following report was given by a grower in San Benito County. The amount of labor and cost of production are staggering, but the returns are of the same magnitude.

1. The land was prefertilized with 5 tons per acre of chicken manure at a cost of $9.00 per ton spread.

2. Preirrigation was at a cost of $6.00 per acre.

3. The land was worked up into 30-inch beds and planted two rows on a bed.

4. The seed was planted on October 1 at a cost of $2.50 per acre.

5. The field was cultivated twelve times at a cost of $1.50 per acre per time or $18.00 per acre total.

6. On November 1 the pansies were thinned to 2 to 3 inches at a cost to the grower of $150.00 per acre.

7. Dust was applied six times during the season at an estimated cost of $8.00 per acre per time.

8. The field was hoed five times at a cost of $10.00 per time or a total cost per acre of $50.00.

9. Harvesting and threshing were completely done by hand labor at an estimated cost of $4.50 per pound of seed. Pickers go over the beds every two to four days to select and pick pods which have reached a proper stage of maturity.

10. The resulting financial statement was a shown below:

Total growing cost per acre:	
Fertilizer	$ 45.00
Preirrigation	6.00
Land preparation	5.00
Planting	2.50
Cultivation	18.00
Thinning	150.00
Dusting	48.00
Hoeing	50.00
	$324.50
Yield per pound:	
1949 (100 pounds)	$ 22.50
1950 (16 pounds)	14.00
Harvesting and threshing cost:	
1949	$450.00
1950	72.00
Returns per acre:	
1949	$1,526.00
1950	173.50 (loss)

Petunia Seed.

1. Land is plowed and disked, and possibly floated, to give smooth surface.

2. The petunias are transplanted in the months of March and April.

3. It is generally necessary to irrigate soon after planting plus two to three additional irrigations.

4. Dust and spray for "stock borers" and mildew are used. Petunias must be watched closely in the early part of the season for various diseases.

5. Three to five cultivations are required during the season in addition to hoeing twice to control weeds. There is no thinning as the plants are transplanted.

6. The seed is harvested in August; the plants are pulled by hand and spread on sheets to dry. After one to two weeks' drying, they are run through a threshing machine.

Petunias will average from 75 to 100 pounds per acre of seed.

Zinnia Seed.

Zinnias are planted for seed in the months of April and May. It is necessary to wait until after the frost season is over as zinnias will not stand a hard frost. The land is worked up into 36-inch beds, and the seed

is planted two rows to a bed. Some growers plant only one row to a bed, but that seems to be the exception. The land is generally prefertilized with about 400 pounds per acre of some complete fertilizer such as 10-10-5 or 10-15-10. Seed is planted at the rate of about 1-1/2 pounds per acre which gives a heavy stand, later being thinned to 14 to 18 inches. Thinning takes place after about thirty days or when the plants are about 1-1/2 to 2 inches in height.

Zinnias require considerable irrigation--six to seven times during the season. They are irrigated as soon after planting as possible and through the season until thirty days before maturity (about the last part of July). Some growers use 50 pounds per acre of ammonia gas with the July irrigation, and others use phosphoric acid to supply additional phosphorous about sixty days after planting.

Four cultivations during the season are generally necessary together with two hand hoeings to control the weeds. In some areas the native morning glory plant is quite troublesome.

It is usual to dust three times in the season for numerous pests. When the zinnias are young, there is possible thrip damage; later on, the corn ear worm, corn ear maggot, and mildew must all be controlled. The most popular dust used is 5 per cent D.D.T. and sulfur applied by air in 35- to 40-pound per acre doses.

The seed is harvested in October and November, after the frost, either by machine or hand labor. There is a gain of 75 to 80 pounds per acre of seed by using the hand labor as the direct combining causes some loss in yield, but the labor is expensive and often hard to get in sufficient quantities. After the seed is hand cut or machine cut with a mower-type cutter, it is dried in the field for four or five days. The threshing is usually done by the seed company at a charge to the grower.

The contract price for zinnias was reported as 90 cents for the mixed zinnias.

Zinnia Seed--Operations.

1. Plow and disk two times.

2. Work up land into 36-inch beds and plant 1-1/2 pounds per acre in two rows on a bed. Plant in April and May.

3. Prefertilize 400 pounds per acre with 10-10-5; later in the season, add 100 pounds per acre of ammonia gas.

4. Thin to 14 to 18 inches when the plants are 2 inches high (thirty days after planting).

5. Irrigate seven times during the season, the first application being as soon after planting as possible and the last irrigation being about thirty days before the zinnias reach maturity.

6. Cultivate four times.

7. Hoe two times by hand.

8. Dust three times with 5 per cent D.D.T. at the rate of 40 pounds per acre by air.

9. Thresh by hand and pile on sheets to dry.

10. Harvesting done by the seed company with a direct charge to the grower.

TABLE 13

Inputs Per Acre for Zinnia Seed Production (9-Hour Day)

Yield 350 Pounds

Operations	Crew and equipment	Acres per day	Man time	Total	Tractor time	Total
Plowing	1M 20T 3-14" plow	6.0		1.5		6.0
Disking (2 times)	1M 20T 10' double disk	20.0	.45	0.9	.45	0.9
Making beds	1M 20T 3-row lister	8.0		1.1		1.1
Planting	2M 20T 6-row planter	15.0	.6	1.2		0.6
Prefertilizing	1M 10T 4-row cultivator with fertilizer attachment	12.0		0.8		0.8
Thinning	3 M/hrs.			30.0		
Irrigating (7 times)	3 M/hrs.			21.0		
Cultivating (4 times)	1M 10T 3-row cultivator	15.0	.6	2.4	.6	2.4
Hoeing (2 times)	10 M/hrs.			20.0		
Harvesting (hand)	60 M/hrs.			60.0		
Threshing	Contract					
	Total			138.9		7.3

Cost Per Acre for Zinnia Seed Production

	Hours	Rate per hour	Total cost
Labor			
Tractor driver	7.3	$1.00	$ 7.30
Thinning	30.0	.75	22.50
Irrigating	21.0	.75	15.75
Hoeing	20.0	.75	15.00
Harvesting	60.0	.75	45.00
Total labor cost			$105.55
Tractor			
10 h.p. wheel	3.2	$ .75	$ 2.40
20 h.p. track	4.1	1.25	5.12
Total tractor cost			$ 7.52

(Continued on next page.)

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Cost Per Acre for Zinnia Seed Production (Continued)

	Hours	Rate per hour	Total cost
Equipment			
Plow--3-14"	1.5	$ .15	$ .25
Disk--10' double	0.9	.27	.24
Lister--3-row	1.1	.39	.43
Planter--6-row	0.6	.11	.07
Cultivator--4-row	2.4	.18	.43
Fertilizer attachment	0.8	.06	.05
Total equipment cost			$1.47
	Amount	**Cost per unit**	**Total cost**
Contract			
Threshing		$20.00	$20.00
Total contract cost			$20.00
Materials			
Fertilizer	400 lbs.	$80.00	$16.00
Irrigation water	3.5 acre-ft.	3.00	10.50
Ammonia gas	100 lbs.	.10	10.00
Dust--5 per cent D.D.T. and sulfur	120 lbs.	8.00	9.60
Total material cost			$46.10
Miscellaneous			
Taxes			$10.00
Compensation insurance ($2.45 per $100.00 payroll)			2.50
Total miscellaneous cost			$12.50

Total cost per acre	$183.34
Total cost per pound	.52

APPENDIX A

Abbreviations

The meaning of the various abbreviations as used in the cost tables is as follows:

Abbreviation	Meaning
M	Man or men
M/hrs.	Man-hours
T	Tractor
T10 or 10 h.p.	Tractor (10 horsepower)
T20 or 20 h.p.	Tractor (20 horsepower)
Cwt.	Hundred pounds

APPENDIX B

Basic Costs

Man labor:	
Tractor driver	$1.00 per hour
General (transplanting, irrigating, hoeing, thinning, harvesting--including threshing)	.75 per hour
Use of tractor:	
10 h.p. wheeled--not including driver	.75 per hour
20 h.p. track--not including driver	1.25 per hour
Charge for use of equipment:	
Cultivator--3-row	1.62 per day
Cultivator--4-row	1.98 per day
Disk--10-foot double	2.52 per day
Fertilizer attachment	.72 per day
Furrower--3-row	1.50 per day
Harrow--20-foot spike	.72 per day
Lister (for making beds)--3-row	2.40 per day
Planter--3-row	2.00 per day
Planter--6-row	2.50 per day
Plow--3 14-inch	2.70 per day
Rotary hoe	1.20 per day
Transplanter--3-row	2.70 per day
Vine cutter (for peas)	1.00 per day
Contract work:	
Use of thresher (when hired)	$1.25 to $1.50 per hour
Airplane dusting (D.D.T.)	.05 per pound
Materials:	
Fertilizer--10-10-5	$80.00 per ton
17-7-0	72.00 per ton
Ammonia gas	.10 per pound
Irrigation water	3.00 per acre-foot
5 per cent D.D.T. (same price if mixed with sulfur)	8.00 per cwt.

Seed stock (including beet and carrot roots):

Usually supplied by the contracting seed company. Exceptions are:

1. Cases where a charge of $20.00 to $25.00 per acre is made for table beet stock.
2. Occasional charges for seed, viz., lettuce seed (1 pound per acre at $2.50) and garden peas (60 pounds per acre at 6-1/4 cents).

Taxes (on land and equipment):

Seed-producing crops occupy the greater part of the year so that single cropping is the rule (garden peas are a possible exception). Therefore, a tax of $10.00 per acre per year is used in our calculations of costs.

APPENDIX B

Basic Costs

Man labor:	
Tractor driver	$1.00 per hour
General (transplanting, irrigating, hoeing, thinning, harvesting--including threshing)	.75 per hour
Use of tractor:	
10 h.p. wheeled--not including driver	.75 per hour
20 h.p. track--not including driver	1.25 per hour
Charge for use of equipment:	
Cultivator--3-row	1.62 per day
Cultivator--4-row	1.98 per day
Disk--10-foot double	2.52 per day
Fertilizer attachment	.72 per day
Furrow--3-row	1.50 per day
Furrow--20-foot spike	.72 per day
Lister (for making beds)--3-row	2.40 per day
Planter--3-row	2.00 per day
Planter--6-row	3.50 per day
Plow--3 12-inch	2.70 per day
Rotary hoe	1.20 per day
Transplanter--3-row	2.70 per day
Vine cutter (for peas)	1.00 per day
Contract work:	
Use of thresher (when hired)	$1.25 to $1.50 per hour
Airplane dusting (D.D.T.)	.05 per pound
Materials:	
Fertilizer--4-10-5	$60.00 per ton
17-7-0	72.00 per ton
Ammonia gas	.10 per pound
Irrigation water	3.00 per acre-foot
5 per cent D.D.T. (same price if mixed with sulfur)	8.00 per cwt.
Seed stock (including beet and carrot roots):	

Usually supplied by the contracting seed company. Exceptions are:

1. Cases where a charge of $20.00 to $25.00 per acre is made for table beet stock.
2. Occasional charge for seed, viz., lettuce seed (1 pound per acre at $2.50) and garden peas (60 pounds per acre at 6-1/4 cents).

Taxes (on land and equipment):

Seed-producing crops occupy the greater part of the year so that single cropping is the rule (garden peas are a possible exception). Therefore, a tax of $10.00 per acre per year is used in our calculations of costs.

APPENDIX C

Cost of Farming Operations (Made up of Labor and Charge for Use of Implements and Machinery) (9-Hour Day)

Operations	Crew and equipment	Cost per day	Daily output	Cost per acre
		dollars	acres	dollars
Plowing	1M 20T 3-14" plow	22.95	6	3.82
Disking	1M 20T 10' double disk	22.77	20	1.14
Harrowing	1M 20T 20' spike harrow	20.97	60	.35
Making beds	1M 20T 3-row lister	22.65	8	2.83
Planting	2M 20T 6-row planter	29.50	15	1.97
Transplanting	4M 20T 3-row transplanter	56.55	22	2.57
Fertilizing	1M 10T 3-row cultivator with fertilizer attachment	18.09	12	1.51
Cultivating	1M 10T 3-row cultivator		12	1.36
	1M 10T 4-row cultivator	17.37	15	1.12
Furrowing	1M 20T 3-row furrower	21.75	30	.72
Irrigating	3 M/hrs. per application			2.25
Threshing	4M 10T thresher	59.00	4	14.88

APPENDIX C

Cost of Farming Operations (Made up of Labor and Charge for Use of Implements and Machinery) (9-Hour Day)

Operations	Crew and equipment	Cost per day	Daily output	Cost per acre
		dollars	acres	dollars
Plowing	1M 2OT 3-14" plow	22.95	6	3.82
Disking	1M 2OT 10' double disk	22.77	20	1.14
Harrowing	1M 2OT 20' spike harrow	20.97	60	.35
Making beds	1M 2OT 3-row lister	22.65	8	2.83
Planting	2M 2OT 6-row planter	29.50	15	1.97
Transplanting	4M 2OT 3-row transplanter	56.55	22	2.57
Fertilizing	1M 1OT 3-row cultivator with fertilizer attachment	18.09	12	1.51
Cultivating	1M 1OT 3-row cultivator		12	1.36
	1M 1OT 4-row cultivator	17.37	15	1.12
Furrowing	1M 2OT 3-row furrower	21.75	30	.72
Irrigating	3 M/hrs. per application			2.25
Threshing	1M 1OT combiner	59.00	4	14.88